SYSTEM AND METHOD FOR SHARING, VIEWING, AND CONTROLLING MULTIPLE INFORMATION SYSTEMS

STATEMENT OF RELATED PATENT APPLICATIONS

This non-provisional patent application claims priority under 35 U.S.C. § 119 to U.S. Provisional Patent Application No. 60/419,983, titled *System and Method for Sharing, Viewing, and Controlling Multiple Computer Systems*, filed October 21, 2002. This provisional application is hereby fully incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to a system and method for sharing, viewing, and controlling multiple information systems and more specifically to computer and telecommunication systems and computer implemented methods for sharing information between a wide variety of telecommunications and computer system components.

BACKGROUND OF THE INVENTION

Advances in computer networking and high-speed communications have supported the almost instantaneous sharing of information. One example is videoconferencing, which enables groups of individuals at remote locations to see and hear each other and provide audio-visual presentation effects in real time across a computer network and telecommunication system.

Often, a goal of a videoconference is to allow remote parties to collaborate. This collaboration may include working together on a drawing set, editing a word processor document, or manipulating a spreadsheet. Computer software running on desktop computers over a network has been developed that enhances the capability of individuals to collaborate with remote groups. This software includes providing "white boards" for participants to use, where everyone can see the board, to desktop sharing, where one

participant can let other participants see her desktop. An example of a program that enables desktop sharing is the open-source program VNC.

Another application of information sharing is monitoring remote computer desktops. This monitoring may support network maintenance, such as troubleshooting a problem at a specific machine or monitoring the status of a number of machines. Alternatively, this monitoring may facilitate computer-based instruction, as where a teacher can monitor activities taking place on a student's desktop. Software currently exists to support these monitoring activities.

Despite these advances in desktop sharing computer software, the amount of information that can be passed over networks containing the desktop computers is finite. Bandwidth, the information-carrying capacity of the telecommunications links between the computer networks, is a valuable resource. Many of the desktop sharing tools tax the bandwidth capability between network systems. The large bandwidth use is attributable to one desktop sending a full-size image across the network to a second desktop, which may or may not resize that image. A constant challenge to telecommunications between computer systems is to limit the drain on the bandwidth resource.

Another limitation is the telecommunication resources that can participate in a collaboration. Large-scale videoconferencing allows participants in remote locations to attend meetings as if they are at a single table, by providing video and audio links between the locations. These videoconferences may be connected over dedicated communication lines or over a distributed network, such as the internet. To connect videoconference calls between parties (endpoints) on different networks, the networks must have specialized equipment. This equipment includes codecs, multipoint control units (MCUs), gateways, gatekeepers, multipoint-capable endpoints, and desktop computers with direct connections to ISDN or other telecommunications lines. A codec, or coder-decoder is the core (or "engine") of a video conference system and is responsible for all of the encoding and decoding of information (audio and video). Before the

transmission, the codec converts analog signals to digital signals and compresses the digital signals. Incoming audio and video must be decompressed and converted from digital back to analog.

MCUs, which are made up of both hardware and software components, are needed to support teleconferences with more than four participants and are an expensive resource for a network. MCUs have multiple ports to manage the call flow-control and processes and to distribute the audio, video, and data streams to the videoconference participants. Networks can have multiple MCUs. Gateways, which can be hardware and/or software, connect network endpoints to endpoints outside the network over ISDN or other telecommunications lines. Gatekeepers are software programs that manage bandwidth within a network zone. LANs may be divided up into zones. A gatekeeper manages bandwidth use for a particular network zone and determines if connections between zones have sufficient bandwidth to carry a videoconference call. Multipoint-capable endpoints are essentially mini MCUs and can videoconference with three other endpoints without using an MCU. Finally, an endpoint, such as a desktop computer on the LAN, can have a direct connection to an ISDN or other telecommunications line. If this endpoint needs to connect to a videoconference involving others outside that endpoint's network zone, the call can be initiated without using an MCU. Although a desktop computer can participate in this type of large-scale video conference, this participation is typically limited to audio and video over a peripheral camera or displaying a presentation to other participants, such as by using a software program such as POWERPOINT, by the Microsoft Corporation , Redmond, Washington.

The prior art includes client-to-client desktop sharing applications. This architecture, coupled with the inability of the desktop source to adjust the size of its desktop to a variety of sizes before the desktop image is sent, fails to address the demand for bandwidth that accompanies these desktop sharing programs. The applications constantly poll the desktop for the other computers, constantly using bandwidth resources.

What is needed is a source-to-server-to-client computer-implemented method and system that enables the functionality of information sharing, yet limits the amount of bandwidth required to implement that functionality. This need includes the capability of sharing information within a common system between large-scale videoconferencing resources, personal computers, and other telecommunication resources.

SUMMARY OF THE INVENTION

The present invention provides a computer implemented method and system for sharing information between telecommunication resources. These resources may include desktop computers, codecs, network workstations, and other telecommunication resources, such as a telephone.

One aspect of the present invention provides a system that includes one or more telecommunications or computing resources, each having an adapter module operable to translate one or more data items from the one of the resources and to distribute the translated data items in response to a change in one or more of the data items. The system also includes a system server module, operable to received translated data items from an adapter module and further operable to process the data items. Upon processing, the system server module distributes the processed data items to one or more of the resources.

In another aspect of the present invention a method for sharing information is provided, which includes the steps of (1) capturing a data instance from a telecommunications or computing system resource; (2) translating the data; (3) sending the translated data to a system server module; (4) capturing a second data instance; (5) if the second data instance is different from the first input data instance, than translating the second data instance; and (6) if the second data instance is different from the first input data instance, sending the translated second data instance to the system server module.

In another aspect of the present invention, a method for sharing data between a videoconferencing system and a personal computer is provided, which includes the steps of (1) capturing a data instance from the videoconferencing system; (2) translating the data instance; (3) sending the translated data instance to a system server module; (4) processing the data instance into an output data instance by the system server module; (5) distributing the output data instance to an adapter module associated with the personal computer; (6) translating the output data instance; and (7)presenting the output data instance by the personal computer.

Another aspect of the present invention provides a a method similar to the method above but involving sharing information among one or more personal computers.

The aspects of the present invention may be more clearly understood and appreciated from a review of the following detailed description of the disclosed embodiments and by reference to the drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 provides a network diagram illustrating a representative operating environment for an exemplary embodiment of the present invention.

FIG. 2 provides a block diagram illustrating representative functional components for an exemplary embodiment of the present invention.

FIG. 3 provides a flow diagram presenting a process for sharing information between telecommunication and computer resources in accordance with an exemplary embodiment of the present invention.

FIG. 4 provides a flow diagram presenting a process for establishing a meeting involving telecommunication resources in accordance with an exemplary embodiment of the present invention.

FIG. 5 provides a flow diagram presenting a process for sharing information between a personal computer resource and other telecommunications resources in accordance with an exemplary embodiment of the present invention.

FIG. 6 provides a flow diagram presenting a process for sharing information between a videoconferencing resource and other telecommunications resources in accordance with an exemplary embodiment of the present invention.

FIG. 7 provides a flow diagram presenting a process for sharing information between a telephone resource and other telecommunications resources in accordance with an exemplary embodiment of the present invention.

FIG. 8 provides a block diagram illustrating personal computers sharing display screens in accordance with an exemplary embodiment of the present invention.

FIG. 9a depicts bandwidth performance of an exemplary embodiment of the present invention.

FIG. 9b also depicts bandwidth performance of an exemplary embodiment of the present invention.

FIG. 9c also depicts bandwidth performance of an exemplary embodiment of the present invention.

FIG. 9d also depicts bandwidth performance of an exemplary embodiment of the present invention.

FIG. 10 presents a display image illustrating a desktop computer window used to conduct information sharing in accordance with an exemplary embodiment of the present invention.

FIG. 11 presents a display image illustrating a shared computer desktop in accordance with an exemplary embodiment of the present invention.

FIG. 12 presents a display image illustrating a shared computer desktop of a single meeting participant in accordance with an exemplary embodiment of the present invention.

FIG. 13 presents a display image illustrating a shared computer desktop of a single meeting participant that has been updated in response to a change at the image source in accordance with an exemplary embodiment of the present invention.

FIG. 14 presents a display image illustrating multiple shared computer desktops in accordance with an exemplary embodiment of the present invention.

FIG. 15 presents a display image illustrating a shared computer desktop of one of participants of a meeting in accordance with an exemplary embodiment of the present invention.

FIG. 16 presents a display image illustrating a shared computer desktop of one of participants of a meeting that has been detached from a window presenting the meeting in accordance with an exemplary embodiment of the present invention.

FIG. 17 presents a display image illustrating sharing computer desktops from multiple meeting resources, with each screen displayed at 160 pixels by 120 pixels, in accordance with an exemplary embodiment of the present invention.

FIG. 18 presents a display image illustrating sharing computer desktops from multiple meeting resources, with each screen displayed at 320 pixels by 240 pixels, in accordance with an exemplary embodiment of the present invention.

FIG. 19 presents a display image illustrating sharing computer desktops and video images from multiple meeting resources, with each screen displayed at 320 pixels by 240 pixels, in accordance with an exemplary embodiment of the present invention.

FIG. 20 presents a display image illustrating sharing computer desktops and video images from multiple meeting resources, with each screen displayed at 160 pixels by 120 pixels, in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Exemplary embodiments of the present invention provide a system and computer-implemented method for sharing information between multiple and varied telecommunications resources, while limiting the use of computer network bandwidth.

FIG. 1 provides a network diagram illustrating a representative operating environment **100** for an exemplary embodiment of the present invention. Referring to **FIG. 1**, this operating environment **100** includes a personal computer **120** connected to a system server **110**. The operating environment also includes a workstation **130**. This workstation **130** is connected to a distributed network **140**. The distributed network **140** may be a LAN or wide-area-network (WAN), such as the internet. The workstation **130** may be a personal computer or computer terminal. Also connected to the distributed network **140** is a personal computer **150**. The personal computer **150** is capable of running a software application, such as a web browser, for translating information provided in hypertext markup language (HTML). The distributed network **140** is connected to the server **110** by a dedicated or other telecommunications line, such as a T1, ISDN, DSL, or other line. Alternatively, this connection may be through a wireless communications network.

The operating system **100** also includes a videoconferencing system **160**, which may include a codec, which may link to the system server **110** through an MCU. The operating environment **100** also includes a telephone **170**.

One skilled in the art would appreciate that alternative operating environments could be used. For example, the operating environment can include components on a common LAN. Alternatively, the distribution network **140** could be multiple, independent distributed networks, with different components connected to the system server **110** through different distributed networks. Also, an alternative operating environment may not have all of the types of telecommunication components illustrated in the operating environment **100** and this alternative operating environment may have

multiple occurrences of a single component type. Also, an alternative operating environment may include telecommunication components not contained in the operating environment **100**, such as a portable digital assistant (PDA) or videophone.

FIG. 2 provides a block diagram **200** illustrating representative functional components for an exemplary embodiment of the present invention. Referring to **FIGS. 1** and **2**, in this exemplary embodiment, computer software modules include a system server module **210** and an adapter module **260**. The system server module **210** may include a number of virtual servers, such as virtual server A **220** up to virtual server N **230**. The system server module **210** instantiates a single virtual server to correspond to a single meeting. This virtual server exists for as long as the corresponding meeting exists. Once the meeting ends, the system server module **210** extinguishes the corresponding virtual server. The system server module **210** may instantiate any number of virtual servers to facilitate information sharing.

A meeting is defined as a sharing of information between two or more resources. These resources may include personal computers, videoconferencing equipment, or other telecommunication equipment and the meeting may involve resources of a single type or of varying type. For example, if two personal computers want to share information, such as by collaborating on a document contained on one of the personal computers, the system server module **210** would instantiate a virtual server that corresponds to that collaboration, or meeting.

Each virtual server corresponding to a meeting, such as virtual server A **220** or virtual server N **230**, may include addition virtual servers, such as virtual server A1 **240** and virtual server A2 **250**, which are associated with virtual server A **220**. These additional virtual servers **240, 250** are instantiated by the system server **210** to handle specific tasks within a meeting. These tasks may include gathering information from or distributing information to a specific resource. When a specific task within a meeting is no longer needed, the virtual server instantiated for that task is extinguished, such as when a specific resource disconnects from a meeting. One skilled in the art would

appreciate that software module configurations, other than virtual servers, could be developed to perform the methods described here.

The adapter module **260** is associated with a client, or resource. The adapter module **260** may reside on a resource, such as the personal computer **120**. Alternatively, the adapter module **260** could reside on an intermediate system component, such as a component on the distributed network **140**, like a web server, or an MCU. Also, the adapter module **260** could reside on the system server **110**.

The adapter module **260** includes a resource module **270** and a consumer module **280**. The resource module **270** is associated with tasks that deliver information from a client to the system server **110**. For example, the resource module **270** translates the desktop image of the personal computer **120** and distributes that image to the system server module **210** resident on the system server **110**. The consumer module **280** is associated with tasks that deliver information to the client. For example, the consumer module **280** may receive information corresponding to an audio and video stream from the videoconferencing system **160** from the system server module **210** and translate that information into input that can be presented on a display device of the personal computer **120**. One skilled in the art would appreciate that the resource module **270** and consumer module **280** may include a variety of object-based programs that perform specific tasks within the overall function of the module and that the delineation between modules could be different.

FIG. 3 provides a flow diagram presenting a process **300** for sharing information between telecommunication and computer resources in accordance with an exemplary embodiment of the present invention. Referring to **FIGS. 1**, **2**, and **3**, at step **310**, the system server **110**, through the system server module **210**, establishes a meeting including two or more resources, also referred to herein as clients, devices, or components. This step is discussed in greater detail below, in connection with **FIG. 4**.

At step **315**, a resource detects and captures an input instance. In this step, a resource detects and captures input independent of the resource's participation in a meeting. For example, a videoconferencing system **160** may capture audio and video from a group of people in front of a camera that is part of the videoconferencing system **160**. The audio and video information is coded by a codec component. In another example, a video card in a personal computer **120** may capture an image that corresponds to the desktop image of the personal computer **120**.

At step **320**, the resource module **270** of the adapter module **260** that is associated with the resource involved in step **315** receives a request from the system server module **210** to send information. In response to this request, at step **325**, the resource module **270** translates the input instance captured at step **315**. Some resources, such as the telephone **170**, are not responsive to requests from the system server module **210**. For these resources, the step **320** is skipped and the resource module **270** translates information periodically or as necessary.

At step **325**, the resource module **270** translates the captured data into a form that can be transferred to the system server module **210**. For an image, such as the image of a desktop, this step **325** includes translating the image to a size equal to the greatest requested size less than or equal to the actual size of the image. The requested size may be specified at step **310** or received at step **320**. For example, a desktop image may be 1024 by 768 pixels in size. Other meeting participants may request the image at a size of 160 pixels by 140 pixels or 640 pixels by 480 pixels. The image would be translated to the maximum size request, or the actual size of the image, if smaller. This process is discussed in greater detail below, in conjunction with **FIG. 8**.

At step **330**, the resource module **270** sends the translated input to the system server module **210**. At step **335**, a virtual server, such as virtual server A **220**, that was instantiated by the system server module **210** and that corresponds to the specific task of managing the input from the resource processes the received input. At this step, the information may be formatted to satisfy parameters specified by other resources involved

in the meeting. At step **340**, the virtual server distributes the processed information to the client adapter modules for other meeting participants that can or want to receive the information. For example, other personal computers, video conferencing equipment, or a videophone may receive a desktop image from a resource, while a regular telephone may not receive that image.

At step **345**, a client consumer module **280** for one of the resources that are receiving the information distributed at step **340** receives the information. At step **350**, the consumer module **280** translates the information for the client device. For example, this step may include translating the information to be received by a video card in a personal computer so that the information can be displayed on a computer monitor associated with that personal computer. At step **355**, the resource presents the translated data.

At step **360**, the process **300** determines if the device from step **315** has additional information for the meeting. Typically, a device will continually provide information throughout a meeting as long as the device is participating in the meeting. Once the device drops off a meeting, the process **300**, at step **360**, would move to step **365** and terminate the process. The entire process has been presented as a series of steps. One skilled in the art would appreciate that some steps may occur in parallel. For example, while the system server module **210** processes and distributes information, individual resources may be capturing, translating, and distributing new information to the system server module **210**.

Although a device, or resource, participating in a meeting will typically continually deliver information to a meeting, if a certain information type has not changed, then that information will not be sent. For example, if the image of a desktop has remained the same, that image will not be constantly sent by the resource module **270** to the system server module **210**. Instead, the image will be sent only after it changes. This feature limits the use of valuable bandwidth, by sending images only when they have changed, rather then at some constant rate. This beneficial bandwidth performance

is discussed in greater detail below, in connection with **FIG. 9**. One skilled in the art will appreciate that not all resources can take advantage of this feature. For example, a video camera continually captures frames of data and may not be capable of determining if the image has changed or may be in a dynamic environment, such as a room with people, where the image changes from frame to frame. In this case, the information is updated as requested at a periodic rate.

FIG. 4 provides a flow diagram presenting a process **310** for establishing a meeting involving telecommunication resources in accordance with an exemplary embodiment of the present invention. Referring to **FIGS. 1, 2, 3,** and **4,** at step **410,** a meeting is defined on the system server module **210** that resides on the system server **110**. The meeting may be defined by actions from one or more client resources through an adapter module **260**. For example, a user may indicate, through a personal computer **120** with an adapter module **260** resident on the personal computer **120**, one or more resources that will participate in a meeting. This indication may specify the participants and the type of resource for each participant. One user or multiple users may provide this indication to the system server module **210**. Alternatively, a meeting may be initiated on an ad hoc basis. In this alternative, each resource may contact the system server module **210** to participate in a meeting at that time.

At step **420**, at the time of the meeting, a communication link is established between the system server **110** and the resources that will participate in the meeting. This communication link could be initiated by a resource, such as by entering a universal resource locator (URL) address into a browser or by dialing into a network, or by the system server **110**.

At step **430**, in response to establishing a communications link between a resource and the system server **110**, the system server module **210** instantiates one or more task-specific virtual servers for conducting the meeting. At step **440**, the resources specify input parameters that they require from other meeting participant resources. For example, an adapter module **260** resident on the personal computer **120** may specify the

size of the images from other participants that the user requires and what input that adapter module **260** will provide, such as desktop images, chat capability, and audio/video from a peripheral device attached to the personal computer **120**. A virtual server associated with the meeting and associated with supplying information to a specific consumer module **280** will maintain information on the requested information parameters of that specific resource, such as the requested image size.

Although these request parameters are provided at the establishment phase of a meeting, they may be changed throughout the course of the meeting. The system server module **210** is responsive to updates to the required input parameters specified by each meeting participant. Following this step, the process **310** moves to step **315** of process **300**.

FIG. 5 provides a flow diagram presenting a process **500** for sharing information between a personal computer resource and other telecommunications resources in accordance with an exemplary embodiment of the present invention. This process **500** provides a specific implementation of process **300** involving a personal computer **120**. Referring to **FIGS. 1**, **2**, **3**, **4**, and **5**, at step **505**, the system server **110**, through the system server module **210**, establishes a meeting including two or more resources, including at least one personal computer **120**. This step is discussed in greater detail above, in connection with **FIG. 4**. At step **510**, a resource module **270**resident on the personal computer **120** receives a set of request parameters. These parameters may be initially established at step **440** of process **310**. These parameters may specify the types and quality of information to be supplied to the system server module **210** from the adapter module **260** resident on the personal computer **120**.

At step **515**, a component of the personal computer **120** detects and captures an input instance. For example, a video card in the personal computer **120** may capture an image that corresponds to the desktop image of the personal computer **120**. In another example, a software application capable of conducting chats, or real-time messaging, may

detect that text has been entered into a data entry user interface that corresponds to the chat capability.

At step **520**, the resource module **270** of the adapter module **260** resident on the personal computer **120** receives a request from the system server module **210** to send information. In response to this request, at step **525**, the resource module **270** translates the input instance captured at step **515**. Some input instances from step **515** may be sent by the resource module **270** to the system server module **210** without receiving a request. For example, a chat message may be sent from the resource module to the system server module **210** as soon as the message is captured. For these input instances, the step **520** is skipped.

For an image, such as the image of a desktop, this step **525** includes translating the image to a size equal to the greatest requested size less than or equal to the actual size of the image. The requested size parameter may be received at step **510** or received at **520**, such as when a resource participating in the meeting has modified its required input parameters. For example, a desktop image may be 1024 by 768 pixels in size. Other meeting participants may request the image at a size of 160 pixels by 140 pixels or 640 pixels by 480 pixels. The image would be translated to the maximum size request, or the actual size of the image, if smaller. This process is discussed in greater detail below, in conjunction with **FIG. 8**.

At step **530**, the resource module **270** sends the translated input to the system server module **210**. At step **535**, a virtual server, such as virtual server A **220**, that was instantiated by the system server module **210** in process **310** and that corresponds to the specific task of managing the input from the personal computer **120**, processes the received input. At this step, the image may be formatted to satisfy parameters specified by other resources involved in the meeting. For example, a desktop image may be resized to meet the requirements of a specific resource that will consume the desktop during the meeting. At step **540**, the virtual server distributes the processed information to the client adapter modules for other meeting participants that can or want to receive the

information from the personal computer **120**. For example, other personal computers or video conferencing equipment may receive a desktop image from the personal computer **120**, while a telephone may not receive that image.

At step **545**, a client consumer module **280** for one of the resources that are receiving the information distributed at step **540** receives the information. At step **550**, the consumer module **280** translates the information for the client device. For example, this step may include translating the information to be received by a video card in a second personal computer, such as personal computer **150**, which may be connected to the meeting through a web browser, so that the information can be displayed on a computer monitor associated with that personal computer **150**. At step **555**, the resource presents the translated data.

At step **560**, the process **500** determines if the personal computer **120** has additional information for the meeting. Typically, a device will continually provide information throughout a meeting as long as the device is participating in the meeting. As such, the process will continually loop back to step **515** as long as the personal computer **120** is participating in the meeting. Once the personal computer **120** drops off the meeting, the process **500**, at step **560**, would move to step **565** and terminate the process as to the personal computer **120**. The meeting may continue with other participants. The entire process has been presented as a series of steps. One skilled in the art would appreciate that some steps may occur in parallel. For example, while the system server module **210** processes and distributes information, individual resources may be capturing, translating, and distributing new information to the system server module **210**.

Although a device, or resource, participating in a meeting will typically continually deliver information to a meeting, if a certain information type has not changed, then that information will not be sent. For example, if the image of a desktop on the personal computer **120** has remained the same, that image will not be constantly sent by the resource module **270** to the system server module **210**. Instead, the image

will be sent only after it changes. This feature limits the use of valuable bandwidth, by sending images only when they have changed, rather then at some constant rate. This beneficial bandwidth performance is discussed in greater detail below, in connection with **FIG. 9**.

FIG. 6 provides a flow diagram presenting a process **600** for sharing information between a videoconferencing resource and other telecommunications resources in accordance with an exemplary embodiment of the present invention. Referring to **FIGS. 1, 2, 3**, and **6**, at step **610**, the system server **110**, through the system server module **210**, establishes a meeting including two or more resources, where at least one of those resources is a videoconferencing system **160**. This step is discussed, in general terms, in greater detail above, in connection with **FIG. 4**.

At step **615**, a codec device detects and captures an input instance. In this step, a resource detects and captures input independent of the resource's participation in a meeting. For example, the videoconferencing system **160** may capture audio and video from a group of people in front of a camera that is part of the videoconferencing system **160**. The audio and video information is coded by the codec component.

At step **620**, the resource module **270** of the adapter module **260** that is associated with the videoconferencing system **160** receives a request from the system server module **210** to send information. This resource module **270** may reside on a PC-based server that a videoconferencing endpoint can contact, the codec, the MCU, or other videoconferencing device for the videoconferencing system **160** capable of running the software module.

In response to this request, at step **625**, the resource module **270** translates the input instance captured at step **615**. The videoconferencing system **160** is continuously capturing audio and video input at a location. However, this information may be sent to the system server module at a frequency that is less than this capture frequency. As such,

this less frequent request rate may result in a fraction of the captured frames sent to the system server module **210**.

For a video image from the videoconferencing system **160**, this step **625** may include translating the image to a size equal to the greatest requested size less than or equal to the actual size of the image. The requested size may be specified at step **610** or received at step **620**. Alternatively, the image may be sent to the system server module **210**, which then resizes the image.

At step **630**, the resource module **270** sends the translated input to the system server module **210**. At step **635**, a virtual server, such as virtual server A **220**, that was instantiated by the system server module **210** and that corresponds to the specific task of managing the input from the videoconferencing system **160** processes the received input. At this step, the image may be formatted to satisfy parameters specified by other resources involved in the meeting. At step **640**, the virtual server distributes the processed information to the client adapter modules for other meeting participants that can or want to receive the information. For example, personal computers or other video conferencing equipment may receive an image from the videoconferencing system **160**, while a telephone may not receive that image.

At step **645**, a client consumer module **280** for one of the resources that are receiving the information distributed at step **640** receives the information. At step **650**, the consumer module **280** translates the information for the client device. For example, this step may include translating the information to be received by a video card in a personal computer so that the video image from the videoconferencing system **160** can be displayed on a computer monitor associated with that personal computer and the audio component can be played through a sound card in the personal computer. At step **655**, the resource presents the translated data.

At step **660**, the process **600** determines if the videoconferencing system **160** has additional information for the meeting. Typically, the videoconferencing system **160** will

continually provide information throughout a meeting as long as the device is participating in the meeting. Once the videoconferencing system **160** drops off the meeting, the process **600**, at step **660**, would move to step **665** and terminate the process as to the videoconferencing system **160**. The entire process has been presented as a series of steps. One skilled in the art would appreciate that some steps may occur in parallel. For example, while the system server module **210** processes and distributes information, individual resources may be capturing, translating, and distributing new information to the system server module **210**.

FIG. 7 provides a flow diagram presenting a process **700** for sharing information between a telephone resource and other telecommunications resources in accordance with an exemplary embodiment of the present invention. Referring to **FIGS. 1, 2, 3,** and **7**, at step **710**, the system server **110**, through the system server module **210**, establishes a meeting including two or more resources, where at least one of those resources is a telephone **170**. The telephone **170** may be a land line, a cellular phone, or a telephony device. The meeting may be established by the telephone **170** calling into designated server.

At step **715**, the telephone **170** detects and captures an input instance, such as when a user talks into the telephone. At step **720**, the resource module **270** translates the input instance captured at step **715**. For a telephone resource, the adapter module **260** and associated modules, such as the resource module **270**, may reside on an intermediate component, such as a server that is connected to the system server **110** and that can be called from the telephone, or the adapter module **260** may reside on the system server **110**.

At step **725**, the resource module **270** sends the translated input to the system server module **210**. The nature of the telephone is such that whenever an input instance is detected, the resource module **270** translates and sends the input almost immediately. At step **730**, a virtual server, such as virtual server A **220**, that was instantiated by the system server module **210** and that corresponds to the specific task of managing the input

from the telephone **170** processes the received input. At step **735**, the virtual server distributes the processed information to the client adapter modules for other meeting participants that can or want to receive the information.

At step **740**, a client consumer module **280** for one of the resources that are receiving the information distributed at step **735** receives the information. At step **745**, the consumer module **280** translates the information for the client device. For example, this step may include translating the information to be played through a sound card in the personal computer. At step **750**, the resource presents the translated data.

At step **755**, the process **700** determines if the telephone **170** has additional information for the meeting. Typically, a telephone **170** will provide information sporadically throughout the meeting. Once the telephone **170** drops off the meeting, the process **700**, at step **755**, would move to step **760** and terminate the process as to the telephone **170**. The entire process has been presented as a series of steps. One skilled in the art would appreciate that some steps may occur in parallel. For example, while the system server module **210** processes and distributes information, individual resources may be capturing, translating, and distributing new information to the system server module **210**.

FIGS. 5, **6**, and **7** present specific examples of exemplary processes for specific telecommunication components. One skilled in the art would appreciate that other components, such as a PDA connected to a wireless network or a videophone, could be employed in the present invention. Similarly, the processes **500**, **600**, and **700** are directed to a meeting from the point of view of a single meeting component. One skilled in the art would appreciate that these processes may occur simultaneously for any number of resources that are connected to a meeting and that a single system server **110** could host multiple meetings simultaneously.

FIG. 8 provides a block diagram **800** illustrating personal computers sharing display screens in accordance with an exemplary embodiment of the present invention.

The capability of the present invention for providing only the desired resolution of certain types of information during a meeting minimizes the bandwidth used during the meeting. Exemplary embodiments of the present invention rely on a dynamic resource–server-client structure for information sharing. The structure is referred to as dynamic because many information types from a resource can be dynamically resized for optimal transportation across a network. In the example of **FIG. 8**, a resource computer chooses a maximum viewing size for its shared desktop less than or equal to the computer's actual desktop size, known as the maximum source viewing size. Likewise, each client determines the size of the desktop view by picking a viewing size less than or equal to the maximum source viewing size, known as the client requested viewing size. The source desktop then sends updates proportional to the largest client requested viewing size to the server. The server then dynamically generates a resized version of these desktop updates for each of the requested client sizes and sends the appropriate resized desktop updates to each client.

Referring to **FIGS. 2** and **8**, a desktop resource **820** sends the source, a desktop image, at 1024 pixels by 768 pixels, using necessary bandwidth to send this high resolution image to all three clients **840**, **850**, and **860**. With the source-server-client configuration, the high resolution image requested by desktop **860** is sent once from the desktop source **820** to system server **210**. Lower resolution images are then sent to desktop client **840** and **850**, reducing the bandwidth use of the network, while the full image is sent to desktop **860**.

An additional feature of this exemplary embodiment of the present invention is that updated images are sent to the client desktops **840**, **850**, and **860** only when the image changes at the desktop source **820**, rather than periodically as with the prior art. This feature again limits the use of bandwidth, by sending images only when necessary.

FIGS. 9a-9d depict bandwidth performance of an exemplary embodiment of the present invention, from a four-computer trial on a medium sized 100 Mbps corporate LAN with normal traffic. Two machines are source desktops at 1024x768 at 32 bit color

depth with image compression enabled. One machine is acting as the Desktop Server. The final machine is viewing both served desktops as a desktop client. For these tests, low activity is defined as a machine without user input and high activity is defined as a machine with high user input (maximizing windows, moving windows, interacting with the start bar, *etc*). In all results, clients peaked at less than 4 percent of the 100 Mbps bandwidth. Theoretically, in situations with lower bandwidth, the network timed loop should adapt the flow of screen updates for less traffic.

FIG. 9a shows the percentage of bandwidth use with a desktop client viewing two highly active desktops at a 160 pixels by 120 pixels resolution. **FIG. 9b** shows the bandwidth use viewing a highly active 1024 pixels by 768 pixels desktop. **FIG. 9c** shows the bandwidth use from a desktop server client at a 1024 pixels by 768 pixels resolution with no activity. The small peaks are caused by taskbar updates and the large peak is caused by opening the capture window. **FIG. 9d** shows a desktop server with high activity at 1024 pixels by 768 pixels resolution.

FIGS 10-20 provide display images that may be seen by a user in accordance with an exemplary embodiment of the present invention. These display images are used to illustrate functions described above, in conjunctions with **FIGS. 3-7**.

FIG. 10 presents a display image **1000** illustrating a desktop computer window used to conduct information sharing in accordance with an exemplary embodiment of the present invention. Referring to **FIGS. 2** and **10**, a window **1010** generated by an adapter module **260** is shown. The window **1010** provides a series of meeting controls **1020**. These controls include actions **1040**, sharing specifications **1050**, and a chat capability **1060**. The window **1010** also provides a control **1070** that enables a user to select the resolution for display images to be presented within the window **1010**. These display images are provided by other meeting participants and are supplied, at the requested sized, by the system server module **210**.

FIG. 11 presents a display image **1100** illustrating a shared computer desktop in accordance with an exemplary embodiment of the present invention. Referring to **FIG. 11**, window **1110** presents a desktop image **1120** of a meeting participant. This image may be labeled with the name of the user whose desktop is displayed, such as a label "Guy Ettinger" **1130**. The meeting participants, or users, may be listed in a section **1140** of the window **1110**.

FIG. 12 presents a display image **1200** illustrating a shared computer desktop of a single meeting participant in accordance with an exemplary embodiment of the present invention. Referring to **FIG. 12**, a window **1210** may include tabs **1220**, **1230** that enables a user to move from multiview, which may show images from all of the meeting participants to a view of an image from one participant, such as image **1240**. The tab **1220**, which provides the single user view, may have the name of the user on the tab **1220**, such as the user "Guy Ettinger."

FIG. 13 presents a display image **1300** illustrating a shared computer desktop of a single meeting participant that has been updated in response to a change at the image source in accordance with an exemplary embodiment of the present invention. Referring to **FIG. 13**, the window **1310** depicts an image from a single user **1320**. This image **1320** represents an updated desktop image as compared to the image **1240** presented in **FIG. 12**. The exemplary embodiment of the present invention provides updates of information from a meeting participant when they have updated information, such as when their desktop image changes. The window **1310** allows the image **1320** to be displayed at a default size, as indicated in the control **1340**. The window **1310** also has a section **1330** that displays ongoing chats.

FIG. 14 presents a display image **1400** illustrating multiple shared computer desktops in accordance with an exemplary embodiment of the present invention. Referring to **FIG. 14**, the window **1410** presents images from the multiview tab **1420**. The desktop images **1440**, **1450** from two of the meeting participants are shown in the

window **1410**. The meeting participants, including the two participants whose views are shown, are listed in a section **1430** of the window **1410**.

FIG. 15 presents a display image **1500** illustrating a shared computer desktop of one of participants of a meeting in accordance with an exemplary embodiment of the present invention. Referring to **FIG. 15**, the window **1510** presents a view **1540** from a single meeting participant, by a user selecting a tab **1520** corresponding to a participant. The user may also request a size of the displayed image **1540** different from the default size, such as by changing the setting of a control **1530**.

FIG. 16 presents a display image **1600** illustrating a shared computer desktop of one of participants of a meeting that has been detached from a window presenting the meeting in accordance with an exemplary embodiment of the present invention. Referring to **FIGS. 2** and **16**, a window **1610**, corresponding to a view of a desktop of a meeting participant may be detached from the window generated by the adapter module **260**. A user may be able to work on information in this window, such as by editing the information. In this way, the meeting participants may collaborate on a product that may be maintained on one of the participant's computers.

FIG. 17 presents a display image **1700** illustrating sharing computer desktops from multiple meeting resources, with each screen displayed at 160 pixels by 120 pixels, in accordance with an exemplary embodiment of the present invention. Referring to **FIG. 17**, window **1710** presents a multiview of meeting participants, as listed in a section **1720** of the window **1710**. This multiview may be seen by selecting a tab **1730**. The views **1740**, **1750**, **1760**, **1770** may correspond to the users' desktop images.

FIG. 18 presents a display image **1800** illustrating sharing computer desktops from multiple meeting resources, with each screen displayed at 320 pixels by 240 pixels, in accordance with an exemplary embodiment of the present invention. Referring to **FIGS. 17** and **18**, window **1810** presents the same multiview as seen in image 1700. However, the size control **1820** has been used to enlarge the size of the desktop images

1830, 1840, 1850, 1860 (which correspond to the views **1740, 1750, 1760, 1770**). A desktop image, such as image **1850**, may include a video image **1870**, such as one provided by a video camera peripheral to a personal computer.

FIG. 19 presents a display image **1900** illustrating sharing computer desktops and video images from multiple meeting resources, with each screen displayed at 320 pixels by 240 pixels, in accordance with an exemplary embodiment of the present invention. Referring to **FIG. 19**, the window **1910** provides images **1920, 1930, 1940** from meeting participants. These images include images **1920, 1930** from videoconferencing systems. The size of these images, as with the desktop image **1940**, is controlled with a control **1950**.

FIG. 20 presents a display image **2000** illustrating sharing computer desktops and video images from multiple meeting resources, with each screen displayed at 160 pixels by 120 pixels, in accordance with an exemplary embodiment of the present invention. Referring to **FIGS. 2** and **20**, the window **2010** presents display images **2020, 2030, 2040**. These images are from the same three meeting participants as shown in FIG 19. In the image **2000**, the control **2050** was used to request from the system server module **210** a smaller sized image.

One skilled in the art would appreciate that the present invention supports a method and system for sharing information between a variety of telecommunication and computing resources. The system may employ client software modules to connect any combination of these resources to one another through a central server. The operation of the system may reduce the demand for bandwidth on a network as compared to other systems by distributing information from a resource only when that information changes.

Although the exemplary embodiments of the present invention described herein are focused on sharing information in a collaborative meeting setting, the present invention can be employed in other settings, such as a system administrator monitoring the performance of components on a computer network or a teacher monitoring the personal computers of students.